Technical Regulations and Margins of International Trade:
An Empirical Analysis of the Impact of Additional Compliance Requirements Indicator

Kunhyui Kim
Ph.D candidate
Graduate School of Asia-Pacific Studies, Waseda University

Abstract

In the field of international trade, standards and technical regulations, such as Non-tariff measures (NTMs), are gaining more attention during the recent years. Unlike Non-tariff barriers (NTBs), NTMs ensure sound protection for domestic consumers, quality of imported goods, and safety to the environment. However, although NTMs have such sound purposes, past literature report that they often tend to be a disturbance to international trade. In this research, we have constructed an Additional Compliance Requirements Indicator (ACRI) using the newly reported UNCTAD TRAINS NTMs database, to analyze whether additional regulations genuinely hamper international trade and if so, through which channel – the extensive margin or intensive margin of international trade. The Poisson Pseudo Maximum Likelihood (PPML) estimation results show that additional regulations on Sanitary and Phytosanitary (SPS)-related measures hamper international trade via the intensive margin of international trade in the total sample and the extensive margin of international trade in the agriculture sector. On the other hand, additional regulations on Technical Barriers to Trade (TBT)-related measures foster the extensive margin of machinery sector but sabotage the extensive margin of agriculture sector. Apart from the sound purposes listed initially, technical regulations also contribute to product diversification of the machinery sector. Therefore, harmonization of regulations would be a better solution than the complete eradication of NTMs.

Keywords: additional compliance requirement indicator; extensive and intensive margins of international trade; non-tariff measures; Poisson pseudo maximum likelihood; technical regulations.

1. Introduction and literature review

In the field of international trade, standards and technical regulations are gaining more attention during the recent years. Traditional literature on international trade emphasize that tariff reductions, Preferential Trade Agreements (PTAs), and geographical distance, are the explicit obstacles that hamper international trade. Balassa (1966), Calvo-Pardo et al. (2009), and Eaton and Kortum (2002) focused their studies on the unfavorable effect of tariff rates on international trade. Several studies have analyzed the positive effects of Free Trade Agreements (FTAs), such as the reduction of bilateral and multilateral tariff rates, on international trade and regionalization (Baier & Bergstrand, 2007; Kawai & Wignaraja, 2010; Lakatos & Nilsson, 2017; Urata & Kiyota, 2003). Anderson and Van Wincoop (2003) and Chaney (2008) have stressed the unfavorable impact of geographical distance on trade, when applying the traditional gravity model. Nonetheless, rapid reductions of traditional trade costs were insufficient in explaining the recent slow growth of international trade. Some were concerned that Non-tariff measures (NTMs) may act as a hidden barrier for bilateral trade.

This paper aims to find answers to two questions. One, does the imposition of more NTMs by importing countries genuinely hamper international trade? Two, if yes, then through which channel do NTMs exert more significant influence - the extensive margin or intensive margin of international trade? In other words, how does the imposition of regulations by importing countries change the behavior of exporters? Do the exporters resort to diversifying their products or do they start focusing more on incumbent goods? According to UNCTAD (2019), technical regulations comprise of Sanitary and Phytosanitary Measures (SPS), Technical Barriers to Trade (TBT), and pre-shipment inspection. The imposition of SPS and TBT are often related to agricultural goods and manufacturing goods, respectively. Unlike Non-tariff barriers (NTBs), NTMs ensure sound protection for domestic consumers, quality of imported goods, and safety to the environment. NTBs are explicitly meant to restrict imports and include export subsidies, import bans, and even quotas on specific products. NTMs, on the other hand, include requiring the implementation of safety measures such as registration of specific food items for authorization with the Ministry of Health, labelling of potentially hazardous materials, or even requiring licensing for the importation of medicated feed mills, the original purpose of which was not intended to hamper international trade flow. In this

study, we will be referring to technical regulations as NTMs. Standards and technical regulations can often be confused with each other. The significant difference between the two terms is conformity; standards are voluntary measures, whereas technical regulations are official norms enforced by governments. As this paper focuses on documented regulations that are not intended to impede international trade, we will be using the terms *technical regulations*, *regulations*, and *NTMs* interchangeably, to denote technical regulations.

We began this study by assuming that NTMs or technical regulations form part of fixed costs rather than variable costs. As these regulations need to be fulfilled before selling the goods in the foreign market, exporters need to follow the regulations unconditionally, before engaging in the sale. After complying with the NTMs, they can focus on other trade barriers. Michida et al. (2017) further developed Krugman (1980)'s *Love of Variety* model by treating NTMs as fixed costs. They assumed that the certification to validate regulatory measures are marginal for variable costs and, therefore, NTMs mostly affect the fixed costs of international trade. Based on this theory, we postulate that NTMs are part of fixed costs that exporters need to fulfill before penetrating the foreign market. Several studies utilize fixed costs to fill the gap between diminishing trade costs and the slow growth of international trade. Chaney (2008), Lawless and Whelan (2007), and Melitz (2003) emphasize the need for sellers to meet fixed costs before entering the export market. In meeting these fixed costs, less productive firms will fall behind, and only higher productive firms that can surpass their fixed costs will be able to participate in the foreign market.

Past literature has often pointed out that, although NTMs have sound purposes, they disturb international trade. Ghodsi et al. (2017) utilized NTMs data from the World Trade Organization (WTO) Integrated Trade Intelligence Portal (I-TIP) database and showed that TBT overall impedes international trade. Likewise, Fontagné and Orefice (2018) used the Specific Trade Concerns (STCs) data from WTO to examine the impact of TBT measures on international trade. They showed that TBT causes a trade diversion effect and reduces export flows, especially for homogeneous sectors. Fugazza et al. (2017) utilized NTMs data of the Latin American Integration Association (LAIA) proposed by United Nations Conference on Trade and Development (UNCTAD) and the Multi-Agency Support Team (MAST) to show that below-median sized firms incur heavy expenditure in terms of export values due to regulations. Other studies also

show that NTMs cause compliance costs that directly affect firms' competitiveness, eventually sabotaging their international trade flows (Grundke & Moser, 2019; Hoekman & Nicita, 2008).

We have constructed the Additional Compliance Requirement Indicator (hereafter, ACRI) to capture the additional burden borne by exporting countries when entering foreign markets. Past literature often suffers due to lack of information regarding quantification of NTMs. They often construct the number of NTMs, coverage ratio, and frequency index to represent NTMs, which capture only the absolute number of technical regulations imposed by importers, but lack data regarding bilateral differences across nations. Furthermore, the NTMs data available in the STCs database contains only the regulations reported as NTBs by the imposing countries. Hence, the number of NTMs, coverage ratio, and frequency ratio from the database often lack technical and non-trade distorting regulations. Moreover, the WTO I-TIP database reports only those NTMs notified by importers, which may cause data inconsistency across different nations. To overcome these constraints, we constructed bilateral regulatory distance following the concept of Nabeshima and Obashi (2019), using UNCTAD-Trade Analysis Information System (TRAINS) NTMs data. The current research further adopts the newly updated panel NTMs data to examine the impact of NTMs on international trade flow. Previous researches such as those conducted by Cadot et al. (2015), Ing and Cadot (2017), and Kee et al. (2009) already utilized the cross-sectional version of this data.

We add on to the findings of past literature by decomposing international trade flow to the extensive and intensive margins of international trade. The definition of extensive and intensive margins of international trade slightly varies by the literature. However, in this paper, we define extensive margin as the number of products exported and intensive margin as the average value of exports. Chaney (2008), Kuno et al. (2016),[1]and Lawless and Whelan (2007) adopted the above definition of extensive and intensive margins of international trade in their papers.[2] Only a handful of past literature has dealt with the relationship between technical regulations and both the extensive

1 Although Kuno et al. (2016) used the growth in the number of products exported and growth of the average value of exports as extensive and intensive margins of international trade, we have focused on level variables as done by Chaney (2008), and Lawless and Whelan (2007).

2 Chaney (2008) and Melitz (2003) assumed that each firm produces only one differentiated product when constructing their models based on firm activity, whereas this research empirically conducts product-level analysis using the extensive and intensive margins of international trade.

and intensive margins of international trade. Kuno et al. (2016) empirically found that fixed costs hamper both margins of international trade. Bao and Chen (2013) showed that TBT led to product diversification of traded goods and thereby enhanced trade. On the other hand, Shepherd (2015) showed that harmonization of standards leads to product diversification, which is the opposite of the theory proposed by Bao and Chen (2013). As the mixed results indicate, the quantification of technical regulations and missing NTMs data often result in unstable consequences. Therefore, in our paper, we have employed a novel approach of constructing additional regulatory burden for exporters with newly published NTMs panel data, to examine the impact of NTMs on the margins of international trade.

We found that additional technical regulations show mixed results in various sectors. Additional regulations related to SPS negatively affect total trade via intensive margin with statistical significance. The result, however, showed no statistically significant relationship in the machinery and agriculture sectors. Additional TBT-related regulations negatively affect the total extensive margin, but positively affect the extensive margin of machinery sector with statistical significance. As machinery goods are relatively more convenient to diversify than agriculture goods, new firms with enough productivity will manage to meet additional regulations as part of their fixed costs. Our results indicate that additional regulations affect currently traded goods more, as new exporters will find a way to circumvent the regulations and enter the foreign market. Products will be produced in an innovate manner to meet the regulations, which means, regulations will facilitate product diversification. As regulations sort out low-quality goods and firms with low productivity, NTMs contribute to overall consumer safety and environment. SPS and TBT serve as effective instruments to improve market failures, as they protect the environment and prevent hazardous materials from entering the domestic markets. Therefore, we suggest that the mere elimination of NTMs is not the right solution for improving international trade. Rather, harmonization of NTMs in the international market is necessary to take advantage of the sound purposes of NTMs.

The rest of the paper is as follows. Section 2 describes the sample used in this research. Sections 3 and 4 explain the methodology of our empirical analysis and the result thereof. The last section concludes the research with policy implications.

2. Data

2.1. Data for technical regulations

We adopted the newly released panel NTMs researcher file from UNCTAD TRAINS[3] to construct variables for technical regulations. The data covers 92 countries/regions within the period of 2010-2018, wherein the raw source for ASEAN countries is ERIA, 2019 version (Doan & Rosenow, 2019), and the source for the rest of the countries is the UNCTAD TRAINS database. Among the 92 countries, we excluded Occupied Palestinian Territory (PSE) due to the unavailability of export data and Benin (BEN), Belarus (BLR), and Cuba (CUB) due to the lack of Consumer Price Index (CPI) data.[4] We also excluded the 2010-2011 period, in which only the European Union (EUN) had reported any observations. Thus, we constructed ACRI using the data of 88 sample countries for the period between 2012 to 2018, at the importer-exporter-year-product (HS six-digit)-NTMs classification level.[5]

Among the technical measures, the research focuses on SPS and TBT, which follow the MAST 4 classification. Each chapter of the technical measure comprises three levels - one-digit alphabet followed by two-digit numbers.[6] According to UNCTAD (2019), chapters A, B, and C cover SPS measure, TBT measure, and pre-shipment inspection, respectively, while chapters E, F, G, H, and I are closely related to NTBs, which are explicit restrictions on international trade. As pre-shipment inspection consists of formalities that need to pass customs, we have included chapter C when constructing variables for NTMs. Chapters E and F are the *hard measures* that have been used to diminish trade by quantity and price. Chapters G, H, and I may negatively affect trade as they represent import payments, market competition fees, and investments. Moreover, we have excluded A11 and A12, as they are explicit prohibitions of imports and exports; A11 represents prohibitions for SPS reasons, and A12 covers geographical restrictions related to eligibility.

We constructed ACRI using four different samples. First, we constructed the ACRI with chapters A, B, and C, which depict the mixed effect of technical measures and

3 The database is developed by UNCTAD, regional think tanks and universities. It is publicly available from trains.unctad.org.

4 See Appendix A for the total sample countries.

5 NTMs classification follows the 2019 version of three-digit Multi-Agency Support Team (MAST 4 or M4) classification. See UNCTAD (2019) for more details.

6 See Appendix B for the detailed groupings of NTMs.

pre-shipment inspection. Then, we incorporated chapters A and B to construct the ACRI which captures the mixed effect of SPS and TBT. Lastly, we constructed ACRI with each of the chapters A and B to show the individual effect of SPS and TBT, which focus on different groups of products; SPS mostly focuses on agricultural products, whereas TBT usually focuses on machinery goods.

We concorded product classification using the HS 2002 (H2) classification of United Nations Trade Statistics correspondence tables to consistently conduct empirical regression.[7] As the newer version of HS classification often lacks export and import data for developing countries, we used the H2 version of product classification. We then used the trade share of each HS two-digit level sector of the 88 sample countries to aggregate sector-level ACRI. We disaggregated our sample by manufacturing, machinery, and agriculture sectors to examine whether technical regulations have different impacts in each sector; manufacturing sector as HS chapters 28 to 92, machinery sector as HS chapters 84 to 92, and agricultural sector as HS chapters 1 to 24.

2.2. Data for trade values

We extracted H2 versions of HS six-digit product-level bilateral import data in US dollars from the United Nations International Trade Statistics Database (UN COMTRADE) and complemented the missing values with export mirror data. We adjusted for the mirror data by multiplying 1.1, which is the ratio between the cost of insurance and freight (c.i.f) and free on board (f.o.b), following Johansen and Panagakos (1988). We used export mirror data only when the whole sector (HS two-digit) was missing import statistics.[8]

2.3. Other data

The current research employs distance and tariff rates as trade costs. We retrieved the bilateral distance between capital cities from Research and Expertise on the World Economy (CEPII). We used the lowest bilateral tariff rates between Most Favored Nations (MFN) and preferential tariff rates, with the rational assumption that exporters will use the lowest tariff rates when entering the foreign market. We extracted tariff data from the World Bank World Integrated Trade Solutions (WITS) and replaced missing

7 See UNSTATS (2014) for more details.
8 See WITS Online Help (2010) for more details. We deflated the trade value using 2010 as base year (constant US dollar).

values if any, with the Ad Valorem Equivalent (AVE) of each tariff. If tariff rates were missing between two reported years, we filled the missing value with the average value to prevent an abrupt increase in the time frames. Furthermore, we aggregated product-level (HS six-digit) tariff rates to HS two-digit tariff rates using simple means to facilitate the conduction of sector-level analysis.

Price, income and wage data were all taken from the World Development Indicators (WDI). We used CPI for the price, Gross Domestic Product (GDP) per capita of the importer as income, and GDP per capita of the exporter as wage. As these variables report value with importer-exporter-year classification, the coefficient for these variables may not precisely capture the impact of price, income, and wage on the trade values due to lack of product-level or sector-level information.[9]

3. Methodology

3.1. Measurement of technical regulations

In this section, we constructed the ACRI to capture the additional requirements that exporters need to meet before entering the foreign market. The number of technical regulations imposed by importers alone will not be accurate as it will not include the technical regulations that exporting countries are already following. Unlike non-technical regulations often referred to as trade barriers, technical regulations follow internationally harmonized classification (MAST 4) and require mutual recognition between partner countries. Therefore, we captured the additional requirements that exporters need to follow before participating in the foreign market by following and modifying the regulatory distance suggested by Nabeshima and Obashi (2019).

We began by defining a regulatory vector T^{o}_{ipt} implemented by exporting country i (origin country) on product p at time t as:

$$T^{O}_{ipt} = \left(T^{O}_{ipt1},\ T^{O}_{ipt2}, \dots, T^{O}_{iptk}, \dots, T^{O}_{iptK}\right), \tag{1}$$

where T^{o}_{iptk} refers to the number of 3-digit technical measures within k, which is a measure type grouping, as shown in Appendix B.[10] We assumed that, when an exporting country i imposes identical technical measures to all countries without discrimination,

9 We leave these shortcomings for future research.

10 The maximum number of K equals 17. See Appendix B for more details.

exporting firms need to necessarily comply with the regulations for both domestic and foreign production and sales.

Next, we constructed a bilateral regulatory vector in the destination market imposed by the importing country j, against product p of the exporting country i in time t as:

$$T^D_{ijpt} = \left(T^D_{ijpt1},\ T^D_{ijpt2}, \dots, T^D_{ijptk}, \dots, T^D_{ijptK}\right), \tag{2}$$

where T^D_{ijptk} refers to the technical measures within k. Using the vectors representing the technical measures in the origin country (O) and destination market (D), we calculated the additional requirement that country i needs to comply with in order to participate in country j 's market. We first constructed the aggregate number of technical regulations as:

$$T_{ijpt} = \left(T^D_{ijpt1} + T^O_{ipt1},\ T^D_{ijpt2} + T^O_{ipt2}, \dots, T^D_{ijptk} + T^O_{iptk}, \dots, T^D_{ijptK} + T^O_{iptK}\right), \tag{3}$$

which implies that exporters are also imposing technical regulations on foreign goods, and they too need to follow both domestic and foreign regulations. We then applied the cosine similarity between vectors T^O_{ipt} and T_{ijpt} to determine the degree of effectual regulations. The cosine similarity is, therefore,

$$\mathrm{Cos}(\theta)_{ijpt} = \frac{T^O_{ipt} \cdot T_{ijpt}{}'}{\| T^O_{ipt} \| \| T_{ijpt} \|} = \frac{\sum_{k=1}^{K} T^O_{ipt} T_{ijpt}}{\sqrt{\sum_{k=1}^{K}\left(T^O_{ipt}\right)^2}\sqrt{\sum_{k=1}^{K}\left(T_{ijpt}\right)^2}}, \tag{4}$$

where θ implies identical (0 degrees) or orthogonal (90 degrees) relationship between the vectors. The lower the value of "Cos" $(\theta)_{ijpt}$, the lesser the two vectors T^O_{ipt} and T_{ijpt} will be related to each other and vice versa.

Using the cosine similarity, we define ACRI as:

$$\text{“ACRI”}_{ijpt} = 1 - \text{“Cos”}\ (\theta)_{ijpt}. \tag{5}$$

Similar to the result of cosine similarity, ACRI always holds ACRI $_{ijpt} \in [0,1)$, as both exporting and importing countries have at least some technical regulations. ACRI $_{ijpt} = 0$ implies that there is no additional requirement of technical regulations.

For exceptional cases, when only the destination market imposes any technical regulations, meaning that $T^{D}_{ijptk} \neq 0$ and $T^{O}_{iptk} = 0$, we replaced ACRI $_{ijpt} = 1$. For the opposite situation, we replaced ACRI $_{ijpt} = 0$, as there is no additional compliance requirement for exporting firms. When both vectors are 0, we replaced ACRI $_{ijpt} = 0$, as we cannot calculate ACRI. However, we dropped values with ACRI $_{ijpt} = 0$ when the dataset did not report any observations. Lastly, we constructed a weighted average of ACRI $_{ijpt}$ using trade share as:

$$\text{ACRI}^{s}_{ijt} = \sum_{p \in P^{s}_{ijt}} \frac{V_p}{V^{s}} \text{ACRI}_{ijpt}, \tag{6}$$

where s refers to HS two-digit level sectors, and V refers to trade value.

3.2. Extensive and intensive margins of international trade and estimating equations

We defined extensive and intensive margin as the number of goods exported and the average exports per goods, following the framework of Chaney (2008) and Lawless and Whelan (2007). As we defined the extensive margin and intensive margin of international trade at HS two-digit level sectors, we relinquished the assumption that each firm would produce only one differentiated product as Chaney (2008) and Melitz (2003) had assumed, and rather focused on product-level empirical analysis. The total trade value from exporting country i to importing country j in sector s at time t is described as:

$$V^{s}_{ijt} = f\left(F^{s}_{ijt} \cdot \tau^{s}_{ijt} \cdot PL^{s}_{ijt} \cdot I^{s}_{ijt} \cdot w^{s}_{ijt} \cdot \delta^{s}_{ij} \cdot u^{s}_{ijt}\right), \tag{7}$$

where F^{s}_{ijt}, τ^{s}_{ijt}, PL^{s}_{ijt}, I^{s}_{ijt}, and w^{s}_{ijt} are sector-level fixed costs, variable costs, price level, income, and wage, respectively. δ^{s}_{ij} and u^{s}_{ijt} are time-invariant and time-variant error terms. We further decomposed V^{s}_{ijt}, F^{s}_{ijt} and τ^{s}_{ijt} as:

$$V^{s}_{ijt} = N^{s}_{ijt} \cdot \frac{V^{s}_{ijt}}{N^{s}_{ijt}} \tag{8}$$

$$F^{s}_{ijt} = NTM^{s}_{ijt} \cdot \ e^{u^{s}_{F}} \tag{9}$$

$$\tau_{ijt}^{s} = Tariff_{ijt}^{s} \cdot \ Dist_{ij} \cdot e^{u_{\tau}^{s}} \ , \tag{10}$$

where N_{ijt}^{s} refers to the number of goods exported from country i to country j in sector s at time t, whereas $\frac{V_{ijt}^{s}}{N_{ijt}^{s}}$ refers to the average exports per goods in sector s, exported from i to j at time t. u_{F}^{s} and u_{τ}^{s} refer to the error term of each sector-level fixed costs and variable costs. We defined N_{ijt}^{s} and $\frac{V_{ijt}^{s}}{N_{ijt}^{s}}$ as extensive margin and intensive margin of international trade, respectively. We postulated NTMs variable ($NTMs_{ijt}^{s}$) to be a part of fixed costs, as shown in equation (9). Finally, we modified the findings of Helpman et al. (2008) to decompose variable trade costs as a function of tariff rates ($Tariff_{ijt}^{s}$) and distance ($Dist_{ij}$).

We employed the Pseudo Poisson Maximum Likelihood (PPML) estimator to determine equation (7) empirically. As Silva and Tenreyro (2006) discussed using Monte Carlo simulations, OLS estimation often results in heteroskedasticity bias. Our estimation models, therefore, are:

$$V_{ijt}^{s} = lnNTM_{ijt}^{s} + lnTariff_{ijt}^{s} + lnCPI_{jt} + lnGDPPC_{jt} + lnGDPPC_{it} + \delta_{ij}^{s} + u_{ijt}^{s} \tag{11}$$

$$N_{ijt}^{s} = lnNTM_{ijt}^{s} + lnTariff_{ijt}^{s} + lnCPI_{jt} + lnGDPPC_{jt} + lnGDPPC_{it} + \delta_{ij}^{s} + u_{ijt}^{s} \tag{12}$$

$$\frac{V_{ijt}^{s}}{N_{ijt}^{s}} = lnNTM_{ijt}^{s} + lnTariff_{ijt}^{s} + lnCPI_{jt} + lnGDPPC_{jt} + lnGDPPC_{it} + \delta_{ij}^{s} + u_{ijt}^{s}, \tag{13}$$

where $lnNTM_{ijt}^{s}$ refers to the natural logarithm of sector-level ACRI +1 and $lnTariff_{ijt}^{s}$ is the natural logarithm of sector-level tariff rates + 1. $lnCPI_{jt}$ refers to the natural logarithm of consumer price index in the importing country which represents the price level. $lnGDPPC_{jt}$ and $lnGDPPC_{it}$ are the natural logarithms of GDP per capita of importers and exporters, which represent income and wage respectively. We conducted equations (11), (12), and (13) using total sectors, manufacturing sectors, machinery sectors, and agricultural sectors.[11] We controlled for importer, exporter, sector, and year for all regressions; fixed effect. We further conducted robustness checks by adjusting for big jumps in NTMs data. Costa Rica, El Salvador, Guatemala, Honduras, and Panama show a sudden increase or decrease in the number of products due to the imposition of NTMs from 2015 to 2016.

11 See Appendix C for summary statistics of the data.

Also, Venezuela shows an abrupt increase in the number of products due to NTMs imposition in 2017. Therefore, to ensure consistency, we dropped the observations related to Costa Rica, El Salvador, Guatemala, Honduras, and Panama from 2012 to 2015 and the observations related to Venezuela for 2017, for robustness check.

4. Results

Our baseline estimation result for equation (11), which is the technical regulations on total trade value, is summarized in Table 1. Columns (1) to (4) provide the baseline Pooled OLS results using four different ACRI variables. Columns (5) to (8) indicate PPML results. Letters within the parenthesis beside *Log of ACRI* indicate the chapters of technical regulations. For example, *Log of ACRI (ABC)* indicates the natural logarithm of ACRI constructed using chapters A, B, and C of NTMs classification, where chapters A, B, and C refer to SPS, TBT, and pre-shipment inspection, respectively.

Table 1 Baseline Results: Total Trade Value (Total Sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	POLS				PPML			
VARIABLES	Log of Trade Value				Trade Value			
Log of ACRI (ABC)	-0.276***				-0.028			
	(0.027)				(0.067)			
Log of ACRI (AB)		-0.291***				-0.013		
		(0.027)				(0.067)		
Log of ACRI (A)			-0.371***				-0.342***	
			(0.035)				(0.125)	
Log of ACRI (B)				-0.209***				0.020
				(0.029)				(0.068)
Log of Tariff	-0.333***	-0.332***	-0.334***	-0.333***	-0.146***	-0.146***	-0.142***	-0.146***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.037)	(0.037)	(0.037)	(0.037)
Log of Distance	-1.298***	-1.298***	-1.298***	-1.299***	-0.768***	-0.769***	-0.768***	-0.770***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.043)	(0.043)	(0.043)	(0.043)
Log of CPI	0.080	0.083	0.090	0.086	0.708***	0.699***	0.707***	0.680***
	(0.065)	(0.065)	(0.065)	(0.065)	(0.160)	(0.160)	(0.165)	(0.160)
Log of GDPPC (*j*)	2.304***	2.309***	2.265***	2.279***	2.769***	2.754***	2.791***	2.721***
	(0.126)	(0.126)	(0.126)	(0.126)	(0.273)	(0.273)	(0.259)	(0.273)
Log of GDPPC (*i*)	0.336***	0.336***	0.346***	0.351***	0.661	0.661	0.661	0.659
	(0.102)	(0.102)	(0.102)	(0.102)	(0.494)	(0.493)	(0.494)	(0.493)
Constant	-2.077*	-2.118*	-1.888*	-2.076*	-25.951***	-25.745***	-26.205***	-25.274***
	(1.140)	(1.140)	(1.139)	(1.141)	(4.813)	(4.800)	(4.979)	(4.804)
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	562,413	562,413	562,413	562,413	562,413	562,413	562,413	562,413
R-squared	0.478	0.478	0.478	0.478	0.454	0.454	0.455	0.454

*FE refers to importer, exporter, sector (HS two-digit level), and year fixed effect
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

All four ACRI variables show negative and significant coefficients on the total

trade value for POLS results. However, the PPML result only shows the negative and statistically significant result for ACRI composed of chapter A. *Log of ACRI (ABC), Log of ACRI (AB), Log of ACRI (A), and Log of ACRI (B)*, represent the natural logarithm of ACRI constructed by the chapters within the parenthesis, respectively. Here, the estimated results for the ACRI variables indicate that additional regulations on SPS measure can disturb the total traded value. In contrast, the impact of additional regulations on TBT measures has weak or no relationship with the total traded value. Thus, the PPML results show that SPS has considerably more impact on the total trade value, presumably on the agriculture sector.

Tariff rates and distance show the expected results. They hamper not only total international trade flow but also extensive and intensive margins of international trade regardless of the samples, as shown by our regression results throughout the section. Further control variables in the PPML estimation, including the price level of the importing market and income show positive and statistically significant coefficients, whereas wage shows positive but statistically insignificant results.

Table 2 PPML on Extensive and Intensive Margin (Total Sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Extensive Margin				Intensive Margin			
Log of ACRI (ABC)	-0.045***				-0.094			
	(0.011)				(0.084)			
Log of ACRI (AB)		-0.042***				-0.066		
		(0.011)				(0.084)		
Log of ACRI (A)			-0.025				-0.413***	
			(0.018)				(0.117)	
Log of ACRI (B)				-0.030***				-0.016
				(0.011)				(0.086)
Log of Tariff	-0.084***	-0.084***	-0.085***	-0.084***	-0.121***	-0.121***	-0.116***	-0.121***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.033)	(0.033)	(0.032)	(0.033)
Log of Distance	-0.386***	-0.386***	-0.386***	-0.386***	-0.475***	-0.476***	-0.475***	-0.477***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.040)	(0.040)	(0.040)	(0.040)
Log of CPI	-0.224***	-0.224***	-0.228***	-0.225***	0.474***	0.465***	0.478**	0.448**
	(0.013)	(0.013)	(0.013)	(0.013)	(0.180)	(0.180)	(0.186)	(0.179)
Log of GDPPC (*j*)	0.545***	0.544***	0.526***	0.538***	2.345***	2.326***	2.374***	2.295***
	(0.025)	(0.025)	(0.025)	(0.025)	(0.583)	(0.582)	(0.567)	(0.585)
Log of GDPPC (*i*)	0.214***	0.215***	0.216***	0.215***	0.314	0.316	0.315	0.321
	(0.037)	(0.037)	(0.037)	(0.037)	(0.413)	(0.413)	(0.411)	(0.413)
Constant	-6.414***	-6.397***	-6.204***	-6.341***	-16.027**	-15.804**	-16.370***	-15.438**
	(0.463)	(0.463)	(0.462)	(0.464)	(6.304)	(6.294)	(6.232)	(6.315)
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	562,413	562,413	562,413	562,413	562,413	562,413	562,413	562,413
R-squared	0.746	0.746	0.746	0.746	0.282	0.282	0.286	0.283

*FE refers to importer, exporter, sector (HS two-digit level), and year fixed effect
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

Table 2 summarizes the result for equations (12) and (13) for the total sample. All four ACRI variables show negative relationships with both the margins of international trade. The results indicate that ACRI composed of only SPS-related regulations shows a statistically insignificant result for extensive margin, whereas additional regulations of TBT, which is chapter B for NTMs classification, unfavorably affect the number of exported goods with statistically significant coefficients. However, the impact of TBT-related ACRI on the extensive margin is marginal towards the total trade value, as shown in Table 1. SPS-related ACRI, on the other hand, is the only statistically significant variable for the intensive margin among the four ACRI variables. As shown in Table 1, SPS-related ACRI is the only significant variable that negatively affects the total trade value through the intensive margin of international trade. That is, the intensive margin of international trade, which is the average exported incumbent goods by products, largely affects the total trade volume when compared to the extensive margin of international trade. We have further decomposed our analysis for each sector, in the coming paragraphs.

Table 3 PPML on Extensive and Intensive Margin (Manufacturing Sector)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Extensive Margin				Intensive Margin			
Log of ACRI (ABC)	0.003				-0.001			
	(0.013)				(0.083)			
Log of ACRI (AB)		0.008				0.015		
		(0.013)				(0.086)		
Log of ACRI (A)			-0.038				0.470**	
			(0.026)				(0.184)	
Log of ACRI (B)				0.025*				0.034
				(0.013)				(0.087)
Log of Tariff	-0.083***	-0.083***	-0.083***	-0.083***	-0.128***	-0.128***	-0.123***	-0.128***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.046)	(0.046)	(0.046)	(0.046)
Log of Distance	-0.392***	-0.392***	-0.392***	-0.392***	-0.435***	-0.435***	-0.438***	-0.435***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.037)	(0.037)	(0.037)	(0.037)
Log of CPI	-0.235***	-0.236***	-0.233***	-0.238***	0.214	0.210	0.200	0.205
	(0.014)	(0.014)	(0.014)	(0.014)	(0.147)	(0.146)	(0.146)	(0.146)
Log of GDPPC (*j*)	0.516***	0.514***	0.520***	0.506***	1.316***	1.306***	1.248***	1.294***
	(0.028)	(0.028)	(0.027)	(0.028)	(0.345)	(0.342)	(0.347)	(0.344)
Log of GDPPC (*i*)	0.230***	0.230***	0.230***	0.231***	-0.509	-0.508	-0.507	-0.507
	(0.042)	(0.042)	(0.042)	(0.042)	(0.322)	(0.322)	(0.322)	(0.322)
Constant	-3.540***	-3.523***	-3.568***	-3.462***	8.093***	8.166***	8.577***	8.259***
	(0.343)	(0.344)	(0.342)	(0.345)	(2.984)	(2.962)	(2.975)	(2.975)
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	391,991	391,991	391,991	391,991	391,991	391,991	391,991	391,991
R-squared	0.746	0.746	0.746	0.746	0.211	0.210	0.210	0.210

*FE refers to importer, exporter, sector (HS two-digit level), and year fixed effect
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

Table 4 PPML on Extensive and Intensive Margin (Machinery Sector)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Extensive Margin				Intensive Margin			
Log of ACRI (ABC)	0.082***				-0.001			
	(0.025)				(0.153)			
Log of ACRI (AB)		0.084***				-0.020		
		(0.026)				(0.153)		
Log of ACRI (A)			0.007				-0.116	
			(0.047)				(0.469)	
Log of ACRI (B)				0.081***				-0.017
				(0.025)				(0.153)
Log of Tariff	-0.114***	-0.114***	-0.114***	-0.114***	-0.111	-0.112	-0.112	-0.112
	(0.013)	(0.013)	(0.013)	(0.013)	(0.095)	(0.095)	(0.094)	(0.095)
Log of Distance	-0.362***	-0.362***	-0.361***	-0.362***	-0.439***	-0.438***	-0.439***	-0.438***
	(0.016)	(0.016)	(0.015)	(0.016)	(0.065)	(0.065)	(0.066)	(0.065)
Log of CPI	-0.302***	-0.303***	-0.291***	-0.302***	0.007	0.016	0.015	0.014
	(0.030)	(0.030)	(0.029)	(0.030)	(0.396)	(0.385)	(0.385)	(0.384)
Log of GDPPC (*j*)	0.500***	0.498***	0.545***	0.499***	2.273**	2.287***	2.279**	2.285***
	(0.058)	(0.058)	(0.056)	(0.058)	(0.895)	(0.883)	(0.893)	(0.883)
Log of GDPPC (*i*)	0.299***	0.299***	0.296***	0.298***	-0.597	-0.598	-0.598	-0.597
	(0.101)	(0.101)	(0.100)	(0.101)	(0.742)	(0.742)	(0.742)	(0.742)
Constant	-5.277***	-5.255***	-5.780***	-5.262***	-5.642	-5.836	-5.753	-5.800
	(0.932)	(0.933)	(0.911)	(0.933)	(10.719)	(10.509)	(10.614)	(10.511)
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	64,833	64,833	64,833	64,833	64,833	64,833	64,833	64,833
R-squared	0.777	0.777	0.777	0.777	0.330	0.330	0.330	0.330

*FE refers to importer, exporter, sector (HS two-digit level), and year fixed effect
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

Tables 3 and 4 show the PPML results of the manufacturing, machinery, and agriculture sectors, respectively. As shown in Table 3, the manufacturing sector produced insignificant and inconsistent results. As the manufacturing sector comprises most of the HS two-digit group (28 to 92), we narrowed down the sample to the machinery sector (84 to 92). Table 4 shows the PPML results for machinery products. The estimated coefficient of ACRI indicates that ACRI positively affects the extensive margin of international trade. Amongst them all, TBT-related ACRI variables show positive and statistically significant coefficients. On the other hand, none of the ACRI variables show statistically significant results on the intensive margin of international trade, although they all showed negative coefficients. Machinery goods are, as predicted, affected more by TBT than SPS. The results indicate that additional TBT-

related regulations imposed by importing countries boost the product diversification of exporters in the machinery sector. TBT-related regulations may relate to import authorization, licensing requirements, restriction on the usage of specific substances, and the regulations on production processes. The costs for complying with such regulations may be marginal for exporters that already have trade relationships with the foreign market (the intensive margin of international trade). Even those firms that are critically affected by the additional regulations can enter the foreign market again with slightly modified new goods (the extensive margin of international trade). This is because, machinery goods are relatively easier to diversify or produce than agriculture goods. The current fragmented global value chains (GVCs) promote and encourage the fragmentation of products for greater benefits of the global economy. As countries involved in the GVC framework impose technical regulations to ensure consumer health, these technical regulations become the threshold for exporting. In other words, as long as exporters meet the minimum threshold requirements of production networks, technical regulations will not act as a hidden barrier anymore. Rather, they will cause an improvement in the quality of imported goods as new products that meet the regulations will start entering the market. If the costs for complying with the TBT regulations are marginal, either new exporters or incumbent exporters with new goods will enter the market with future incentives to gain benefits in the foreign market. Therefore, additional TBT-related technical regulations will not only affect the currently traded machinery goods but also the potential entrants. Current exporters may stay in the market by diversifying their export goods as additional fixed costs are marginal. On the other hand, new exporters may try to use product innovation to circumvent regulations. Thus, additional regulations will contribute to product diversification of machinery goods.

Table 5 PPML on Extensive and Intensive Margin (Agriculture Sector)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Extensive Margin				Intensive Margin			
Log of ACRI (ABC)	-0.042***				-0.078			
	(0.010)				(0.085)			
Log of ACRI (AB)		-0.042***				-0.108		
		(0.010)				(0.086)		
Log of ACRI (A)			-0.040***				-0.065	
			(0.010)				(0.081)	
Log of ACRI (B)				-0.083***				0.076
				(0.012)				(0.109)
Log of Tariff	-0.093***	-0.093***	-0.093***	-0.093***	-0.142***	-0.142***	-0.142***	-0.141***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.031)	(0.031)	(0.031)	(0.031)
Log of Distance	-0.376***	-0.376***	-0.376***	-0.376***	-0.424***	-0.423***	-0.425***	-0.430***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.035)	(0.035)	(0.035)	(0.035)
Log of CPI	-0.151***	-0.151***	-0.151***	-0.137***	0.287	0.292	0.284	0.252
	(0.030)	(0.030)	(0.030)	(0.030)	(0.194)	(0.195)	(0.194)	(0.197)
Log of GDPPC (*j*)	0.556***	0.557***	0.554***	0.590***	2.117***	2.144***	2.100***	1.968***
	(0.058)	(0.058)	(0.058)	(0.058)	(0.532)	(0.532)	(0.528)	(0.533)
Log of GDPPC (*i*)	0.141**	0.141**	0.142**	0.136**	-0.531	-0.529	-0.526	-0.529
	(0.056)	(0.056)	(0.056)	(0.056)	(0.533)	(0.532)	(0.532)	(0.533)
Constant	-3.606***	-3.617***	-3.602***	-3.977***	-5.096	-5.406	-4.961	-3.465
	(0.870)	(0.870)	(0.870)	(0.873)	(8.055)	(8.057)	(8.023)	(7.977)
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	122,107	122,107	122,107	122,107	122,107	122,107	122,107	122,107
R-squared	0.644	0.644	0.644	0.644	0.116	0.116	0.116	0.116

*FE refers to importer, exporter, sector (HS two-digit level), and year fixed effect
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

Table 5 shows that all ACRI variables negatively affect both extensive and intensive margins of international trade in the agriculture sector, but only statistically significant coefficients affect the extensive margin of international trade. Our study confirmed that when the compliance costs of the NTMs for agricultural goods increase, exporters would rather exit the market than re-enter with different goods. As Melitz (2003) reasons, low productive firms will exit the foreign market as it has become costly and so there is no longer much incentive to stay. The same applies to new exporters that need to comply with the new regulations. They will look for a different market with relatively lower fixed costs, which may cause a trade-diversion effect.

On the other hand, the magnitude of NTMs hardly affects the exporters that already have trade relationships with the importing market (the intensive margin of international trade), similar to the machinery sector. As low productive firms drop out of the market, if incumbent firms comply with the new technical regulations, they can get a higher share in the market. If the benefits that these firms reap are greater than the additional costs stemming from technical regulations, they will be motivated to stay in the market.

Table 1 shows that TBT-related ACRI variables have no statistically significant results. As they show positive coefficients in the machinery sector and negative coefficients in the agricultural sector, we infer that the effect of additional TBT offset each other in the two sectors. On the other hand, SPS negatively affects the extensive margin of international trade in the agriculture sector and the total sector of intensive margin of international trade. Although SPS rarely affects the intensive margin of international trade for separate sectors, SPS-related technical regulations met through the diversification of agricultural goods and the introduction of incumbent goods for the total sample, critically affecting the total international trade flow.

We controlled sudden jumps in the NTMs database to check the robustness of our results. Table 6 confirms that the results are nearly identical between the two samples.

Table 6 Robustness Check: PPML on Extensive and Intensive Margin (Big Jump)

Extensive Margin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Machinery Sector				Agriculture Sector			
Log of ACRI (ABC)	0.011				-0.057***			
	(0.023)				(0.009)			
Log of ACRI (AB)		0.085***				-0.040***		
		(0.026)				(0.010)		
Log of ACRI (A)			0.007				-0.038***	
			(0.047)				(0.010)	
Log of ACRI (B)				0.081***				-0.083***
				(0.025)				(0.012)
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	64,833	64,833	64,833	64,833	122,107	122,107	122,107	122,107
R-squared	0.777	0.777	0.777	0.777	0.644	0.644	0.644	0.644

Intensive Margin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Machinery Sector				Agriculture Sector			
Log of ACRI (ABC)	-0.057				-0.047			
	(0.126)				(0.080)			
Log of ACRI (AB)		-0.020				-0.108		
		(0.153)				(0.086)		
Log of ACRI (A)			-0.116				-0.063	
			(0.469)				(0.081)	
Log of ACRI (B)				-0.017				0.074
				(0.153)				(0.109)
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	64,833	64,833	64,833	64,833	122,107	122,107	122,107	122,107
R-squared	0.330	0.330	0.330	0.330	0.116	0.116	0.116	0.116

*FE refers to importer, exporter, sector (HS two-digit level), and year fixed effect
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

5. Conclusion and policy implication

This paper examines the impact of technical regulations, namely NTMs, on extensive and intensive margins of international trade. Specifically, we focused on how additional regulations imposed by importing countries affect the behavior of exporters. We used the ACRI indicator to calculate the additional regulations that exporters need to comply with before participating in the foreign market, using newly released UNCTAD-TRAINS NTMs data. We used product-level bilateral trade value to construct both margins of international trade. We defined extensive and intensive margin as the number of products traded and the average value of trade value among HS two-digit sectors. Although the results showed mixed effects of additional regulations on international trade, our primary finding is that additional SPS-related technical regulations hamper total international trade flow via the total intensive margin of international trade and the extensive margin of agricultural goods.

Moreover, additional regulations largely influence the extensive margin of international trade by sector: positively on the machinery sector and negatively on the agriculture sector. The effect is massive on agricultural and machinery goods, and marginal on total trade, implying that the effect in agriculture and machinery sectors offset each other. In the machinery sector, additional regulations of TBT-related NTMs result in the introduction of new products as machinery goods are relatively easier to diversify than agricultural goods. These results indicate that additional regulations affect not only currently traded machinery goods but also potential exporters. New exporters would find a way to circumvent or comply with regulations through product innovation. Thus, additional regulations contribute to product diversification of machinery goods.

The limitations of this research are as follows. First, UNCTAD-TRAINS NTMs data possess SPS and TBT measures on both the machinery and agriculture sector. SPS usually affects environmental or agricultural goods, whereas TBT usually affects machinery or manufacturing goods. Therefore, further explanations of the observations on the imposition of SPS on machinery goods and TBT on agricultural goods are necessary. Second, due to missing observation reports of NTMs data, the extensive margin of the machinery sector is larger than that of the agriculture sector. As traditional products usually form a larger portion of final goods, agriculture goods often show more

HS six-digit products than machinery or manufacturing goods. As this research treats missing NTMs observation as *not reported* rather than *no regulations*, our sample may have dropped a large portion of product-level observations on exporter-importer-year-sector level groupings. Lastly, the ACRI still has limitations in capturing the magnitude of the technical regulations. Although the ACRI examines the additional burden on exporters who wish to participate in the foreign market, information on comparable ranking is still ambiguous. For example, when only the importing countries impose technical regulations, regardless of the number of NTMs imposed by the importers, the ACRI result will be one. Also, when there are no technical regulations imposed by the importing countries, regardless of the technical regulations imposed by the exporters, the ACRI result will be zero. We leave the limitation of data availability on NTMs and revision of the calibration of bilateral regulatory burden for future research.

We need to be extra cautious when dealing with technical regulations. Additional regulations may increase consumer utility by diversifying the selection of goods, as explained by the *Love of Variety* explained by Krugman (1980). Moreover, NTMs contribute to the environment and consumer safety by protecting the environment and preventing hazardous materials from penetrating the domestic markets. As our results suggest, additional technical regulations also contribute to the diversification of machinery goods. Mere eradication is not the solution for fortifying the environment of international trade. Therefore, governments need to ensure international harmonization of technical regulations to reduce the trade-distorting effect of NTMs.

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Appendix

Appendix A. NTMs data availability

ISO3	Reporter	2012	2013	2014	2015	2016	2017	2018
AFG	Afghanistan	O	X	X	X	X	X	X
ARE	United Arab Emirates	X	X	X	O	X	X	X
ARG	Argentina	O	O	O	O	O	O	O
ATG	Antigua and Barbuda	X	X	X	X	O	X	X
AUS	Australia	X	X	X	O	O	X	X
BFA	Burkina Faso	O	X	X	X	X	X	X
BGD	Bangladesh	X	X	X	X	X	O	X
BHR	Bahrain	X	X	X	O	X	X	X
BHS	Bahamas	X	X	X	O	X	X	X
BOL	Bolivia	O	O	O	O	O	O	O
BRA	Brazil	O	O	O	O	O	O	O
BRB	Barbados	X	X	X	O	X	X	X
BRN	Brunei Darussalam	X	X	X	O	X	X	O
BWA	Botswana	X	X	X	X	X	O	X
CAN	Canada	X	X	X	O	X	O	X
CHE	Switzerland	X	X	X	O	X	X	X
CHL	Chile	O	O	O	O	O	O	O
CHN	China	X	X	X	X	O	X	X
CIV	Cote d'Ivoire	O	X	X	X	X	X	X
CMR	Cameroon	X	X	X	O	X	X	X
COL	Colombia	O	O	O	O	O	O	O
CPV	Cape Verde	X	X	O	X	X	X	X
CRI	Costa Rica	O	O	O	O	O	O	O
DMA	Dominica	X	X	X	O	X	X	X
DZA	Algeria	X	X	X	X	O	X	X
ECU	Ecuador	O	O	O	O	O	O	O
ETH	Ethiopia	X	X	X	O	X	X	X
EUN	European Union	O	O	O	O	O	X	O
GHA	Ghana	X	X	O	X	X	X	X
GIN	Guinea	O	X	X	X	X	X	X
GMB	Gambia	X	O	X	X	X	X	X
GRD	Grenada	X	X	X	O	X	X	X
GTM	Guatemala	O	O	O	O	O	O	O
GUY	Guyana	X	X	X	O	X	X	X
HKG	Hong Kong	X	X	X	X	O	X	X

HND	Honduras	O	O	O	O	O	O	O
IDN	Indonesia	X	X	X	O	X	X	O
IND	India	X	X	X	X	X	O	X
ISR	Israel	X	X	X	X	O	X	X
JAM	Jamaica	X	X	X	O	X	X	X
JOR	Jordan	X	X	X	X	O	X	X
JPN	Japan	X	X	X	O	O	X	X
KAZ	Kazakhstan	X	X	X	X	X	O	X
KGZ	Kyrgyzstan	X	X	X	X	X	O	X
KHM	Cambodia	X	X	X	O	X	X	O
KOR	Korea, Republic of	X	X	X	X	O	X	X
KWT	Kuwait	X	X	X	O	X	X	X
LAO	Lao PDR	X	X	X	O	X	X	O
LBN	Lebanon	X	X	X	X	O	X	X
LBR	Liberia	X	X	O	X	X	X	X
LKA	Sri Lanka	X	X	X	X	O	X	X
MAR	Morocco	X	X	X	X	O	X	X
MEX	Mexico	O	O	O	O	O	O	O
MLI	Mali	X	X	O	X	X	X	X
MMR	Myanmar	X	X	X	O	X	X	O
MRT	Mauritania	X	X	X	O	X	X	X
MUS	Mauritius	X	X	X	X	X	O	X
MYS	Malaysia	X	X	X	O	X	X	O
NER	Niger	X	X	O	X	X	X	X
NGA	Nigeria	X	O	X	X	X	X	X
NIC	Nicaragua	X	X	O	O	O	O	O
NPL	Nepal	O	X	X	X	X	X	X
NZL	New Zealand	X	X	X	O	O	X	X
OMN	Oman	X	X	X	O	X	X	X
PAK	Pakistan	X	X	X	X	O	X	X
PAN	Panama	O	O	O	O	O	O	O
PER	Peru	O	O	O	O	O	O	O
PHL	Philippines	X	X	X	O	X	X	O
PNG	Papua New Guinea	X	X	X	X	O	X	X
PRY	Paraguay	O	O	O	O	O	O	O
QAT	Qatar	X	X	X	X	O	X	X
RUS	Russian Federation	X	X	X	X	O	X	X
SAU	Saudi Arabia	X	X	X	X	O	X	X
SEN	Senegal	O	X	X	X	X	X	X

SGP	Singapore	X	X	X	O	X	X	O
SLV	El Salvador	O	O	O	O	O	O	O
SUR	Suriname	X	X	X	O	X	X	X
TGO	Togo	X	X	O	X	X	X	X
THA	Thailand	X	X	X	O	X	X	O
TJK	Tajikistan	X	X	X	O	X	X	O
TTO	Trinidad and Tobago	X	X	X	O	X	X	X
TUN	Tunisia	X	X	X	X	O	X	X
TUR	Turkey	X	X	X	X	O	X	X
URY	Uruguay	O	O	O	O	O	O	O
USA	United States	X	X	O	X	X	O	O
VEN	Venezuela	O	O	O	O	O	X	O
VNM	Viet Nam	O	O	O	O	O	O	O
ZWE	Zimbabwe	X	X	X	X	X	O	X

Source: Author's calculation.

Note: See United Nations International Trade Statistics Country Code for ISO3 codes.
Accessible: https://unstats.un.org/unsd/tradekb/knowledgebase/country-code

Appendix B. NTMs groupings

NTMs Group	NTMs within Group
A1	A13, A14, A15, A19
A2	A20, A21, A22
A3	A30, A31, A32, A33
A4	A41, A42, A49
A5	A51, A52, A53, A59
A6	A61, A62, A63, A64, A69
A8	A81, A82, A83, A84, A85, A86, A89
A9	A9
B1	B14, B15, B19
B2	B20, B21, B22
B3	B30, B31, B32, B33
B4	B41, B42, B49
B6	B6
B7	B7
B8	B81, B82, B83, B84, B85, B89
B9	B9
C	C1 C2 C3 C4 C9

Note: NTMs classification follows UNCTAD (2019). The maximum possible number of measures within groups is the total number of NTMs within the group.
Source: Authors' calculation.

Appendix C. Summary Statistics

Total Sample

VARIABLES	(1) Number of observations	(2) Mean	(3) Standard deviation	(4) Minimum value	(5) Maximum value
Trade value	562,413	5.977e+07	1.153e+09	0.00299	2.044e+11
Extensive Margin	562,413	13.02	29.52	1	496
Intensive Margin	562,413	2.336e+06	3.900e+07	0.00299	8.746e+09
ACRI – ABC	562,413	0.361	0.414	0	1
ACRI – AB	562,413	0.348	0.411	0	1
ACRI – A	562,413	0.177	0.335	0	1
ACRI – B	562,413	0.321	0.405	0	1
Tariff	562,413	7.083	8.998	1	336.4
Distance	562,413	8,460	5,461	111.1	19,812
CPI	562,413	124.3	22.28	92.46	348.2
GDPPC (*j*)	562,413	85,426	247,317	384.9	1.014e+06
GDPPC (*i*)	562,413	47,482	165,416	367.6	1.014e+06

Manufacturing Sector

VARIABLES	(1) Number of observations	(2) Mean	(3) Standard deviation	(4) Minimum value	(5) Maximum value
Trade value	391,991	6.411e+07	1.140e+09	0.00299	1.391e+11
Extensive Margin	391,991	15.91	34.51	1	496
Intensive Margin	391,991	1.394e+06	1.798e+07	0.00299	2.467e+09
ACRI – ABC	391,991	0.320	0.397	0	1
ACRI – AB	391,991	0.304	0.392	0	1
ACRI – A	391,991	0.0924	0.235	0	1
ACRI – B	391,991	0.286	0.389	0	1
Tariff	391,991	6.525	6.836	1	54.72
Distance	391,991	8,615	5,493	111.1	19,812
CPI	391,991	124.5	22.41	92.46	348.2
GDPPC (*j*)	391,991	81,313	241,302	384.9	1.014e+06
GDPPC (*i*)	391,991	46,361	161,991	367.6	1.014e+06

Machinery Sector

VARIABLES	(1) Number of observations	(2) Mean	(3) Standard deviation	(4) Minimum value	(5) Maximum value
Trade value	64,833	2.161e+08	2.615e+09	0.0698	1.391e+11
Extensive Margin	64,833	32.80	66.98	1	496
Intensive Margin	64,833	2.549e+06	3.107e+07	0.0598	2.467e+09
ACRI – ABC	64,833	0.331	0.384	0	1
ACRI – AB	64,833	0.319	0.380	0	1
ACRI – A	64,833	0.0644	0.209	0	1.000
ACRI – B	64,833	0.311	0.381	0	1
Tariff	64,833	5.182	5.292	1	45.58
Distance	64,833	8,785	5,431	111.1	19,812
CPI	64,833	124.5	22.23	92.46	348.2
GDPPC (*j*)	64,833	76,405	233,040	384.9	1.014e+06
GDPPC (*i*)	64,833	41,937	150,773	367.6	1.014e+06

Agriculture Sector

VARIABLES	(1) Number of observations	(2) Mean	(3) Standard deviation	(4) Minimum value	(5) Maximum value
Trade value	122,107	2.102e+07	1.653e+08	0.00299	1.325e+10
Extensive Margin	122,107	5.546	7.425	1	91
Intensive Margin	122,107	2.046e+06	1.445e+07	0.00299	2.209e+09
ACRI – ABC	122,107	0.515	0.446	0	1
ACRI – AB	122,107	0.511	0.447	0	1
ACRI – A	122,107	0.488	0.449	0	1
ACRI – B	122,107	0.449	0.444	0	1
Tariff	122,107	8.923	14.00	1	336.4
Distance	122,107	7,970	5,348	111.1	19,812
CPI	122,107	123.7	21.89	92.46	348.2
GDPPC (*j*)	122,107	97,895	264,372	384.9	1.014e+06
GDPPC (*i*)	122,107	51,399	176,978	367.6	1.014e+06

Note: Variables in the summary statistics are raw value before the transformation.
CPI refers to Consumer Price Index, and GDPPC indicates GDP per capita.
Source: Author's calculation.